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Originals

A Karyomorphological Study of Two Species of Japanese *Schoenus* (Cyperaceae)

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Karyomorphological studies were conducted in two species of Japanese *Schoenus*: *S. apogon* and *S. brevifolius*. *Schoenus apogon* had a chromosome number of 2n = 18 and trimodal somatic chromosome karyotypes consisting of 2 large, 14 medium and 2 small chromosomes. The chromosome number of *S. apogon* from New Zealand previously reported as 2n = 8, suggested that Japanese *S. apogon* studied here may belong to a different species from that in New Zealand. *Schoenus brevifolius* had a chromosome number of 2n = ca. 122, with relatively small somatic chromosomes. The chromosome number of 2n = ca. 122 for *S. brevifolius* is the highest in the genus *Schoenus* and is reported in this study for the first time.

Key words: Chromosome number, Cyperaceae, karyotype, *Schoenus apogon*, *Schoenus brevifolius*.

The genus *Schoenus* L. includes approximately 80–100 species that are primarily distributed in Australasia (Goetghebeur 1998, Tucker 2002). Among the Japanese members of *Schoenus*, Koyama (1961) recognized four species: *S. apogon* (Fig. 1), *S. brevifolius*, *S. calostachyus* and *S. falcatus*, which are also widely distributed in Australasia. Japanese *S. apogon* is distributed widely in western Japan (from south of Chiba Prefecture to the Ryukyu Islands), while the other three Japanese species are found in island groups; *S. brevifolius* in the Bonin Islands, and *S. calostachyus* and *S. falcatus* in the Ryukyu Islands.

Chromosome numbers within the genus *Schoenus* have been reported by Labadie (1976), Natarajan (1978), Májovský and Váchová (1986), Javůková-Jarolímová (1992), Scotti et al. (2002) and Lange et al. (2004). Of the species surveyed, the lowest chromosome number in the genus was 2n = 8 for both *S. apogon* var. *apogon* and *S. apogon* var. *caespitans* (Lange et al. 2004), while the highest was 2n = 76 for *S. ferrugineus* (Javůková-Jarolímová 1992). The cytological study of the genus *Schoenus* conducted by Lange et al. (2004) obtained chromosome numbers of 2n = 8, 10, 28, 56, ca. 60, ca. 68 and 74 for seven New Zealand taxa. Accurate karyomorphological studies of Japanese *Schoenus* are thus important for clarifying the evolution and diversification of this genus in Japan.

The purpose of this paper was to determine the chromosome numbers and karyotypes of Japanese *Schoenus*, and to clarify the phylogenetic relationships among related species.

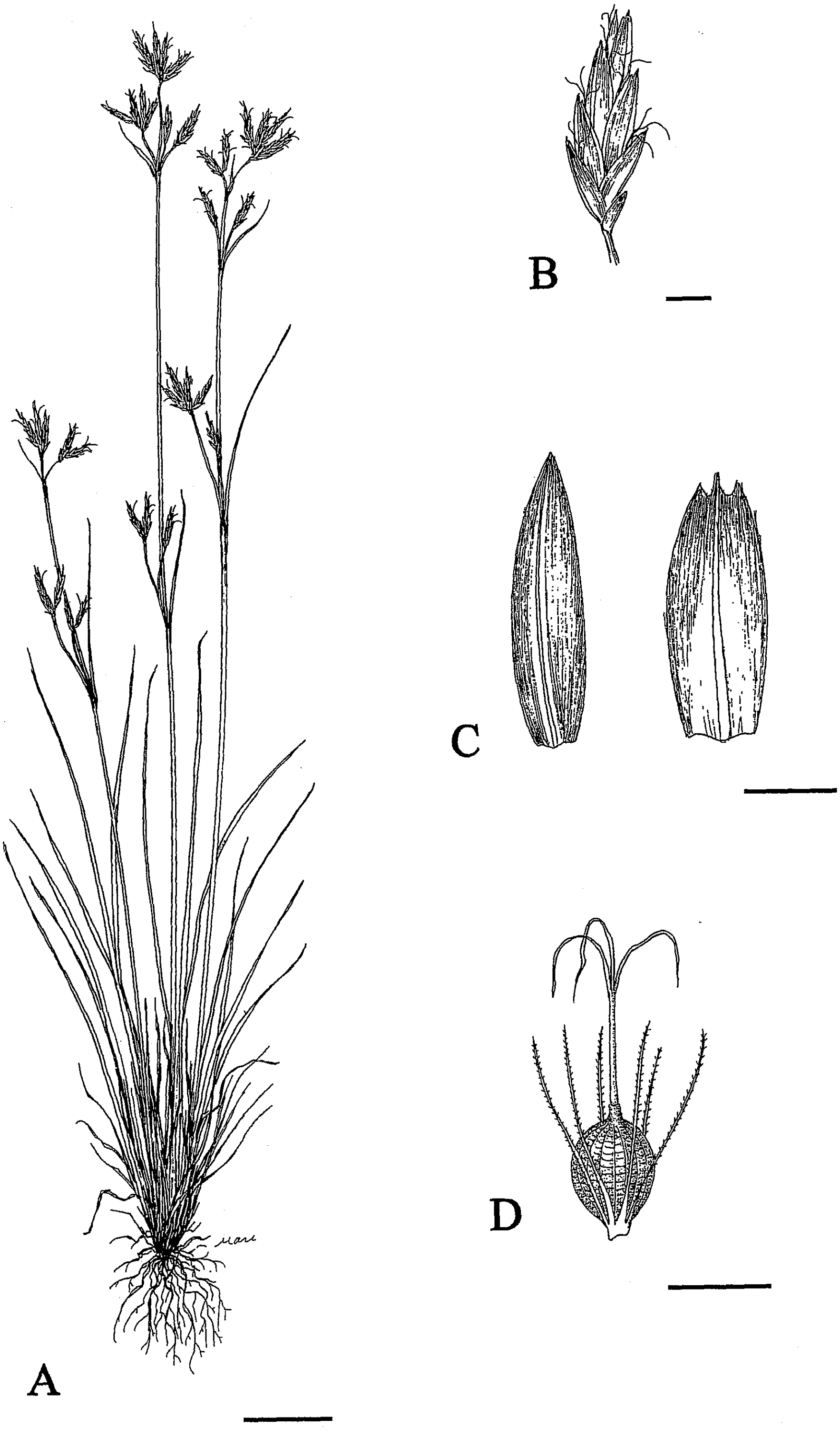

Fig. 1. *Schoenus apogon* var. *apogon*. A. Whole plant. B. Spike. C. Scale. D. Achene. Bar = 1 cm for A, and 1 mm for B–D.

Materials and Methods

Karyomorphological observations were conducted in two Japanese *Schoenus* species. Voucher specimens and localities of the material are listed in Table 1. Somatic chromosomes were obtained from the meristematic cells of root tips. The root tips were pretreated with 0.002 M 8-hydroxyquinoline solution for 1 h at 23°C and 15 h at 4°C. Samples were subsequently fixed with acetic alcohol (1:3) for 1.5 h at 23°C, stained with Feulgen's nuclear reaction, macerated with a mixture of 2% pectinase and 2% cellulase for 1 h at 37°C, restained with 1% aceto-orcein and squashed. Voucher specimens were deposited at the herbarium of the Okayama University of Science (OKAY).

Results and Discussion

Chromosome numbers were determined in *Schoenus apogon* and *S. brevifolius*. The chromosomes of the genus *Schoenus* are thought to be polycentric because primary constriction was not observed in these two species.

Schoenus apogon var. *apogon* collected from Okayama Prefecture in Japan had a chromosome number of 2n = 18, with somatic chromosomes exhibiting trimodal karyotypes (Fig. 2A). The number 2n = 18 is a new chromosome number for *S. apogon*. The 2n = 18 plants had two large chromo-

Table 1. Taxa, locality and voucher, and chromosome numbers of Japanese *Schoenus*

Taxa	Locality and Voucher	Chromosome number; 2n (Karyotype)
Schoenus apogon Roem. & Schult. var. *apogon*		
	Japan, Okayama Pref., Sôja, Okusaka; Hoshino 19950 (OKAY)	18 (2L+14M+2S)
	Japan, Okayama Pref., Bizen, Maeshima; Ikeda & al. 19953 (OKAY)	18 (2L+14M+2S)
S. brevifolius R. Br.		
	Japan, Tokyo Pref., Ogasawara, Chichi-jima; Katsuyama & al. 19875 (OKAY)	ca. 122 (–)

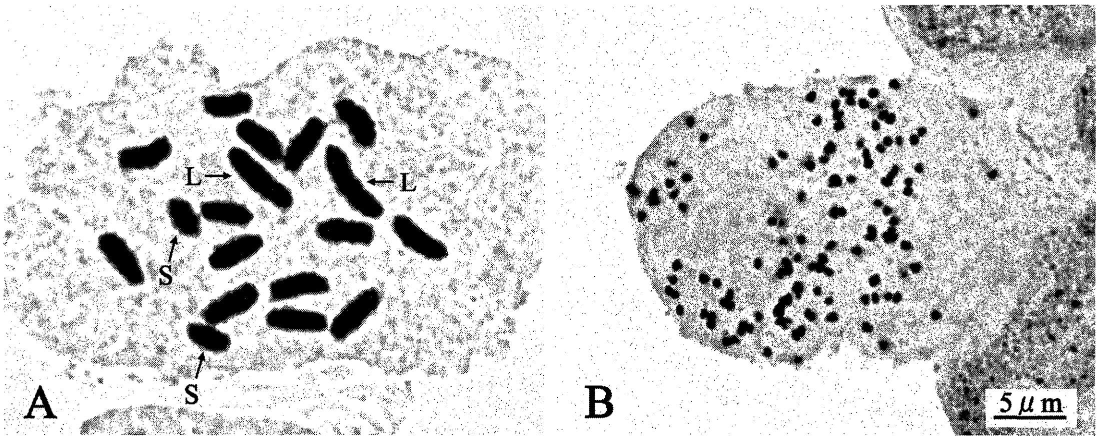

Fig. 2. Photomicrographs of somatic metaphase chromosomes of Japanese *Schoenus*. A. *S. apogon* var. *apogon* (2n = 18). B. *S. brevifolius* (2n = ca.122). Arrows indicate two large chromosomes (L) and two small chromosomes (S).

somes that exceeded 5.9 μm in length, 14 medium chromosomes that ranged from 4.5 μm to 3.6 μm, and two small chromosomes that were less than 3.0 μm in length. Lange et al. (2004) reported $2n = 8$ for *S. apogon* var. *apogon* and *S. apogon* var. *caespitans* collected from New Zealand. The karyotype of the Japanese *S. apogon* var. *apogon* is thus markedly different from the plants from New Zealand. Our results suggest that the Japanese *S. apogon* var. *apogon* with $2n = 18$ may be a different species from the New Zealand plants with $2n = 8$. Japanese *S. apogon* may be distinguished from Australasian *S. apogon* by the length of their perianth bristles. Perianth bristles of Japanese *S. apogon* are longer than the achene (Fig. 1D), while those of Australian are shorter than or equal to the achene (Wilson 1993). Further morphological analyses are needed to clarify the taxonomic and cytological relationships among these species.

Schoenus brevifolius collected from the Bonin (Ogasawara) Islands in Japan had chromosome numbers of $2n =$ ca. 122. The number of chromosomes has been reported for this species for the first time and may be the highest chromosome number in the genus *Schoenus*. The somatic chromosomes of this species, less than 0.9 μm in length, were very small (Fig. 2B). Koyama (1961) suggested that the Japanese *S. brevifolius* is an example of an Australian-Bonin link species and was unable to distinguish it from *S. tenax* of New Zealand. Lange et al. (2004) reported the numbers $2n =$ ca. 60 and ca. 68 for *Schoenus* species from New Zealand. *Schoenus brevifolius* with the number $2n =$ ca. 122 may have arisen by polyploidization from such species as have the number of $2n =$ ca. 60 or ca. 68. In order to clarify the phylogenetic relationships and chromosomal evolution of the Japanese and Australasian members of the genus *Schoenus*, more Australasian species need to be analyzed.

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矢野興一，星野卓二：**日本産カヤツリグサ科ノグサ属植物2種の核形態学的研究**

日本産ノグサ属植物（カヤツリグサ科）2種の核形態学的研究を行なった．日本産ノグサの染色体数は2n = 18 (2L+14M+2S)であり，ニュージーランド産ノグサの染色体数2n = 8 (Lange et al. 2004)とは異なっていた．日本産とニュージーランド産ノグサは，染色体数が異なることから，別種である可能性が考えられる．小笠原諸島産ジョウイの染色体数は2n = ca.122であり，すべて小型の染色体から構成されていた．ジョウイの染色体数2n = ca.122は今回が初めての報告であり，ノグサ属のなかで最も高次の染色体数であることが明らかとなった．

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